

Application guidelines

Danfoss scroll for refrigeration **MLZ for parallel applications**

50Hz - R404A - R507



Introduction	4
Definitions	5
Oil equalization line system.....	5
Oil level regulator system	5
Oil Separator (OS).....	5
Factory oil charge quantity	6
Oil equalization - Passive solution	8
Oil equalization passive solution– No active oil control.....	8
MLZ manifolding piping sizes.....	9
Oil return from the oil separator to suction line	10
Header detail	10
Header outlet fitting	11
Tandem piping designed - Passive solution.....	12
MLZ015-026.....	12
MLZ030-048.....	13
MLZ058-076	14
Oil equalisation - Active oil control.....	15
Oil equalization regulator system – With Active Oil Control	15
Active solution qualification.....	15
Technical features of oil level regulator tested in our laboratories	15
Oil reservoir	16
Oil level regulator	16
Conclusion	18
Oil separator.....	18
Tubbing considerations	22
Suction lines.....	22
Suction header.....	22
Tubbing considerations	23
Suction header configuration with oil	23
Common features for both qualifications	23
Installation and service	24
Operating map.....	24
Total capacity and application envelope.....	24
Compressor mounting	24
Running sequence.....	24
System components	25
Suction line accumulator	25
Suction filter.....	25
Crankcase heater.....	25
Thermostatic Expansion valve.....	25
Spare parts & accessories	26
Magnetic discharge non return valve.....	28

A parallel compressor installation can be defined as a system of compressors interconnected and working together as a common refrigeration circuit. Though several benefits exist for parallel installation, the important benefits are diversification, flexibility, load matching and higher efficiencies, which lead to lower operating costs when compared to single compressor systems.

Though parallel operation of compressors has been around for many areas with reciprocating compressors, their application in scroll compressors has always been a challenge because of lack of external positive displacement oil pump and oil pressure switch to monitor the oil management. Even though Danfoss medium temperature scroll compressors have high performance bearings to provide protection for short periods in case of oil losses, sustained running at high-pressure differences without lubricant will fail the bearings and lead to compressor failure. In order to ensure adequate protection it is necessary to observe all the recommendations highlighted in this application guide.

The following sections will provide recommendations for installation and operation of parallel compressor systems. Since the number of compressors in a parallel system along with specific operational needs varies greatly from operation to operation, this guideline provides a generalized overview only.

Note: To ensure proper parallel installation and running conditions, the following recommendations must be followed:

- It is essential to follow all instructions given in this document, the installation instruction leaflet delivered with every compressor and the MLZ – Refrigeration Scroll compressor's Application Guidelines.
- This application guideline concerns single stage parallel systems for medium temperature application compressors only.
- For additional system components (i.e. oil level regulator, oil separator, ect.), the supplier recommendations must always be followed as failure to comply can result in system damage or personal injury and also these installations are to be performed by persons having the appropriate knowledge, skills and training.

The following are the definitions of some important terms used in the application guide

for medium temperature parallel application compressor systems.

Oil equalization line system

A system which connects compressors sump using sight glass option via an oil line. The oil equalization line system should be used for

parallel rack installations of no more than 2 compressors of the same size / capacity.

Oil level regulator system

A system which provides stable, predictable oil management under nearly all compressor working conditions using an oil regulator and oil separator. The oil level regulator system is highly recommended to be used for parallel rack installations of 2 or more medium temperature compressors.

A device to meter oil into a compressor sump, and control the oil level within limits.

- How does it work: An oil level regulator monitors the oil level in the compressor's crankcase through the incorporated electro-optic level sensor/hall-effect sensor/floating ball. The oil level regulator controls the oil injection by switching the solenoid valve on/off to maintain an acceptable oil level in the compressor crankcase. When the crankcase

oil level cannot be restored in a period of time (setting value) the alarm contactor will be activated and stop the compressor to protect it from damage (some oil level regulators do not have an alarm function)

- Classification: According to the function, there are 3 types of oil level regulators: electronic, electromechanical and mechanical oil level regulator. According to its oil measurement principle, there are 3 types: electro-optic, hall-effect and floating ball. The first two types of oil level regulators use solenoid valves to control the oil level, and the last one uses floating ball valve to control the oil level. For high pressure oil management systems, mechanical type oil level regulator is not recommended.
- Advantages and disadvantages:

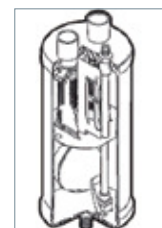
Oil level regulator	Advantages	Disadvantages
Electronic-optical	✓ Sensitive to oil level and judgment precisely. ✓ Reliable for long running ✓ Alarm and protect comp from oil starvation. ✓ Oil feeding logic can be customized ✓ Work status alarm indication by LED ✓ Small, mounted easily	✗ Foaming can affect oil level judgment ✗ Cost expensive
Electronic-Hall effective	✓ Sensitive to oil level and judge oil level without foaming interference. ✓ Alarm and protect comp from oil starvation. ✓ Oil feeding logic can be customized ✓ Work status alarm indication by LED ✓ Small, mounted easily	✗ For long time running, Iron debris can affect oil level judgment, reliable is less than optical sensor. ✗ Cost expensive
Electromechanical	✓ Reliable for long running ✓ Cost cheap ✓ All major components replaceable.	✗ Oil level judgment isn't sensitive ✗ Big, mounted hardly ✗ No status LED indication ✗ Floating ball can be affected by some conditions (temperature, density).

Oil Separator (OS)

There are different types of oil separators in the market.

Impingement (Filter) type OS: Traditionally, this type of OS is widely used in the market; the maximum efficiency is around 80%. They use inlet and outlet metal web to interrupt the oil particles and force them collide with each other, eventually heavier oil particle is formed and drips down to the bottom of OS by gravity. The feature of this type OS is the efficiency goes up with the

gas velocity drops down. For this type of OS, there is option with/without float ball valve. According to marketing's requirement, Hono, AC&R, ALCO OSs are in the scope of the test plan.



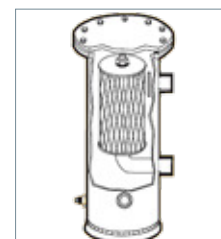
Filter-demister type OS: This type of OS is with a filter cartridge at the end of inlet, sometimes, there are some metallic stuff inside the filter cartridge which has demister function, such as Fasike and Frigomec. The oil separation efficiency is higher than the previous one. Fasike & Frigomec OS is in the scope of our test plan. For passive solution, the OS is selected with

float ball valve to assure there is no gas bypass to compressor oil sump; for active solution with high pressure oil management system, it is without float ball valve, but with oil reservoir function.



Coalescing type OS: Properly designed coalescing separators can remove 95%-99% of the oil component of mass flow. They use a filter media of highly pure glass fibbers, capable of intercepting even the smallest oil molecules. This material forces the molecules to collide and form larger droplets, which in turn are routed by gravity through a drain layer. With this type of OS, after a period of running, the coalescent cartridge

will be saturated and the separation efficiency would drop sharply. And the cost of this type of OS is very high. We didn't qualify this type of OS in our project scope.



Centrifugal type OS: The oil contained in the refrigerant gas collides with the helix guide plate and then flows along the guide plate. The oil particles are separated onto the edge of the helix guide plate and the shell wall by the centrifugal force. The separated oil particles get together and become heavier ones and then drip to the bottom of the OS. For this type of OS, the efficiency can reach to maximum 95%-99%. The feature of the OS is the efficiency drops down with the gas velocity drops down. There is option

with/without float ball valve inside the OS. For passive solution, Carly centrifugal OS with float ball valve is selected to be test; for active solution, Carly OS and Fasike OS without float ball valve are selected to be test.



Factory oil charge quantity

The compressor is shipped from the Danfoss factory with oil charge. The quantity and type is indicated on the compressor label.

The use of an oil separator necessitates an oil fill-up according to the supplier recommendation. Please read the supplier instructions carefully.

Application Guidelines

Model ranges

The Danfoss MLZ refrigeration compressor with its unique scroll design offers a highly efficient solution for demanding refrigeration applications. This range of refrigeration compressors are available from 2 HP to 10 HP at common voltages and frequencies as well as any of the common refrigerants like

R404A-R507. A detailed model offering list for the medium temperature refrigeration scroll family can be obtained online from Danfoss MLZ – Refrigeration Scroll Compressor application guideline – FRCC.PC.015.

Connection version

Model	HP	Factory oil Charge		Suction Tube Size		Discharge Tube Size	
		Oz	L	inches	mm	inches	mm
MLZ015	2	36	1.06	3/4"	19.05	1/2"	12.7
MLZ019	2.5	36	1.06				
MLZ021	3	36	1.06				
MLZ026	3.5	36	1.06				
MLZ030	4	53	1.56	7/8"	20.95	1/2"	12.7
MLZ038	5	53	1.56				
MLZ045	6	53	1.56				
MLZ048	6.5	53	1.56	7/8"	20.95	3/4"	19.05
MLZ058	7.8	90	2.66	1"1/8	28.57	7/8"	20.95
MLZ066	9	90	2.66				
MLZ076	10	90	2.66				

Maintaining adequate oil level in all the compressors is one of the most critical aspects in parallel installations. As in most of the times it is necessary to start and stop compressors independently for capacity control purposes, care must be taken to ensure that an adequate oil

level is maintained at all times in the compressors for the lubrication of the bearings.

To achieve this adequate oil level between all compressors, the two most popular solutions are generally used.

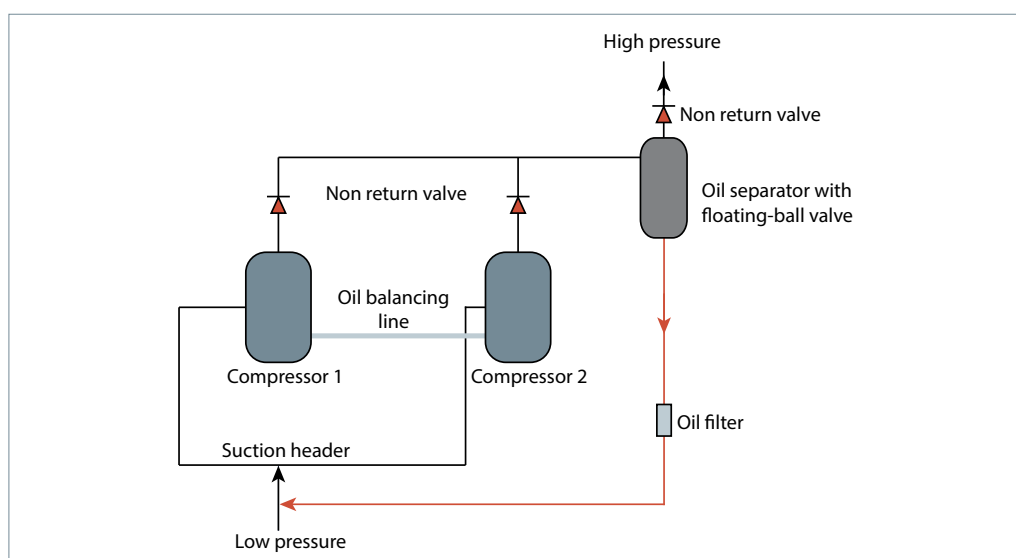
Oil equalization passive solution– No active oil control

This is the most simple and economical system for oil equalization wherein the compressor sumps are connected via tubes with no controls. The linking is done using sight glass fitting located at oil level with a suitable adapter. Danfoss application engineering recommends some guidelines below for this method, but because of wide variations in system design and operating conditions, these methods cannot be given general approval by Danfoss and the system user has to verify that there is always a minimum oil level in the compressors at all operating conditions for successful system installation.

The following are recommendations from Danfoss application engineering when connecting medium temperature compressors using oil equalization system line system without active control:

- A) The oil equalization line system should be used for installations of no more than two compressors of the same size / capacity (No uneven configurations - all same model)
- B) An oil separator with the oil return line main suction heater (see drawing from section "Oil return from the oil separator to suction line") is recommended for all installations
- C) All offered medium temperature model voltages can be used for this method
- D) All approved refrigerants R404A, R507, R22, R134a for medium temperature applications can be used
- E) When only one compressor is needed, in order to get the best oil equalization balance, it is recommended switch compressor running every 15 minutes.
- F) Care must be taken to mount all the compressors on the same horizontal level and also to provide adequate liquid flood back protection when using this method

Passive solution qualification



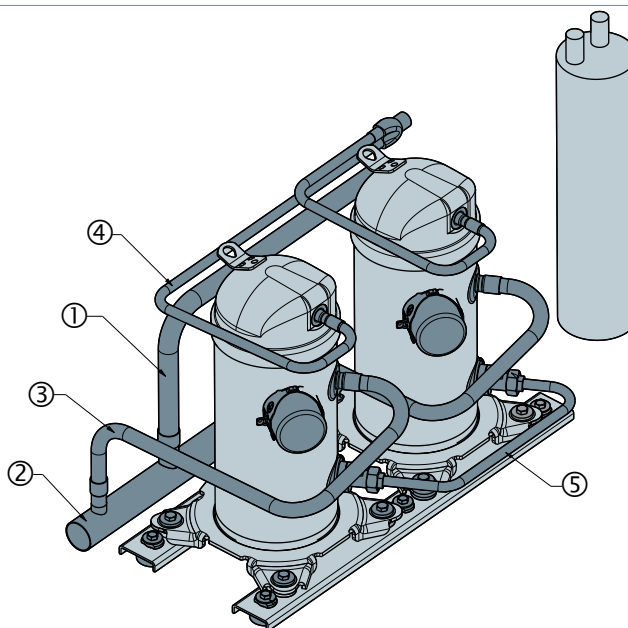
Applicable:

- ✓ For even tandem system only;
- ✓ Using only 1/2" OBL to balance the oil level in two compressors;
- ✓ Oil return is secured by oil separator;
- ✓ Oil return back to main suction line;

- ✓ Suction pipe has suction header, discharge pipe is Y-Joint type;
- ✓ OBL is through OSG with adaptor, no need to modify standard compressor,
- ✓ NRV is recommended for each compressor and the outlet line of oil separator in the system.

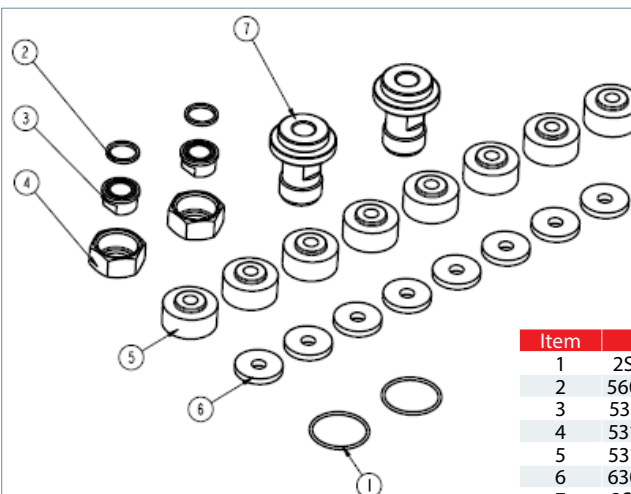
Piping design must be respected according to our drawings from section "Tandem piping designed".

MLZ manifolding piping sizes



	MLZ015-026		MLZ030-045		MLZ048		MLZ058		MLZ066-76	
	Brazed version	Rotolock version	Brazed version	Rotolock version	Brazed version	Rotolock version	Brazed version	Rotolock version	Brazed version	Rotolock version
1	1"	1"	1 1/8"	1 1/8"	1 1/8"	1 1/8"	1 3/8"	1 3/8"	1 3/8"	1 3/8"
2	1 5/8"	1 5/8"	64 mm	64 mm	64mm	64mm	76mm	76mm	76mm	76mm
3	3/4"	3/4"	7/8"	3/4"	7/8"	3/4"	1 1/8"	1 1/8"	1 1/8"	1 1/8"
4	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"	7/8"	3/4"	7/8"	3/4"
5	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"

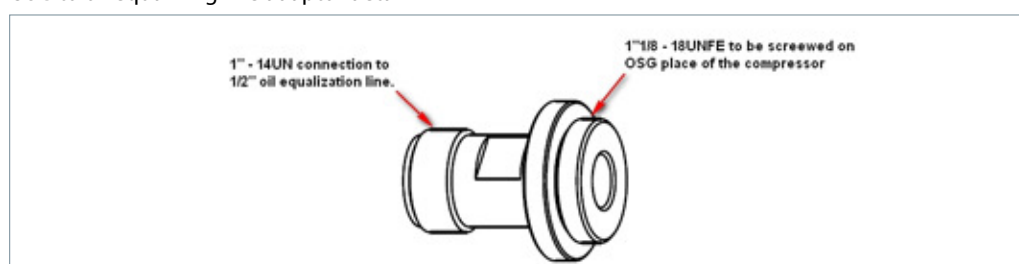
2 oil sight glass adaptors are provided in the manifolding kit 120Z5073 as well as rigid spacers to be placed under compressor feet.



Item	Part no	Description	Quantity
1	2SR7193B01	O-Ring	2
2	5607001P03B	Teflon seal 1"	2
3	5311143P06B	Rotolock sleeve 1"	2
4	5311025P08B	Rotolock nut 1"	2
5	5311629P02B	Spacer	8
6	6301028P01B	Flat washer	8
7	2SR7302B0A	Adaptor	2

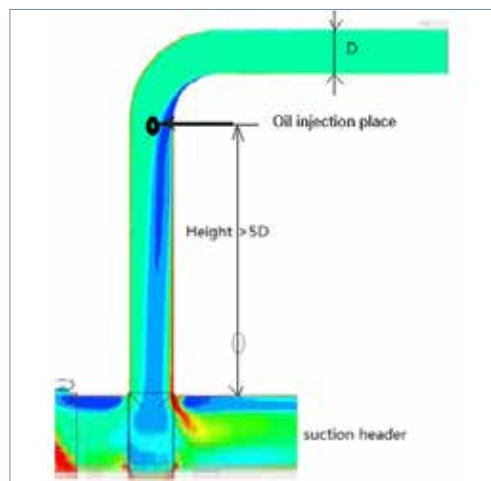
Manifolding service kit 120Z5073

OSG to oil equalizing line adaptor detail



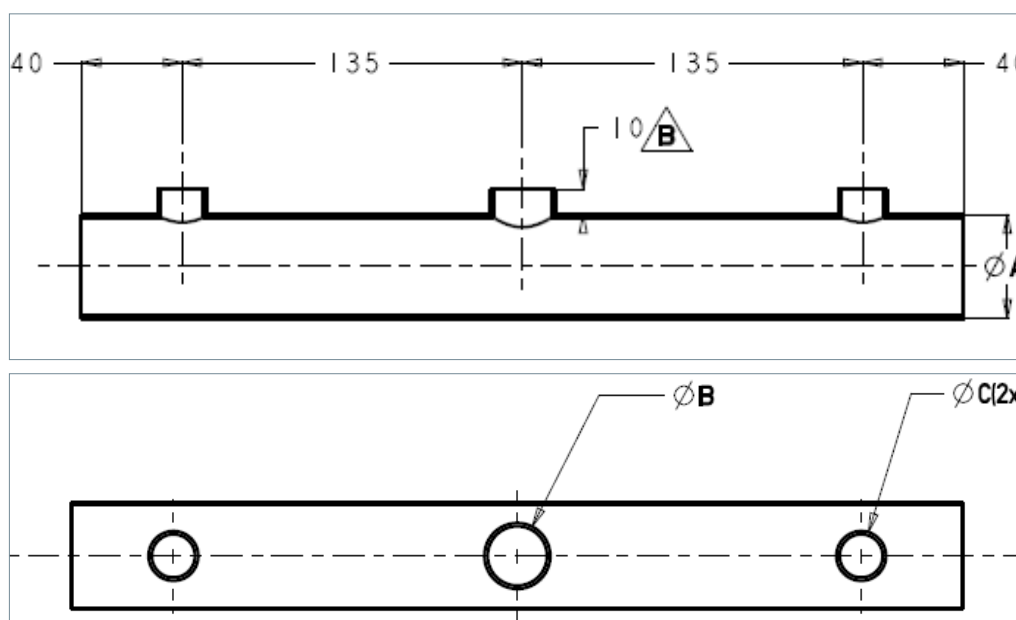
Oil return from the oil separator to suction line

The height of oil injection to suction line position impacts the suction pressure difference. With the test result, we suggest the height of oil injection position to header is more than about 5 times diameter of main suction line, which can reduce gas turbulence and decrease suction pressure differential.



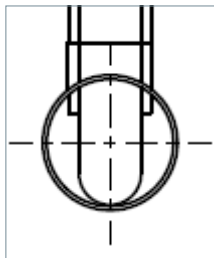
Header detail

In order to insure a perfect oil return the header and suction connections have to be carefully designed.

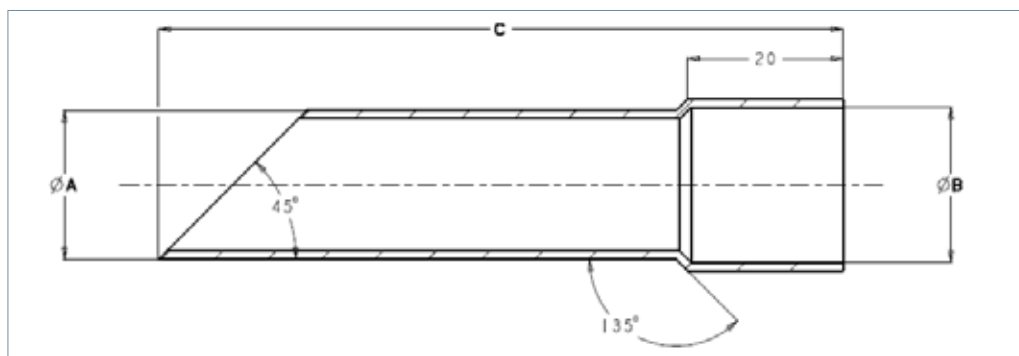


Model	ØA	ØB	ØC	Minimum wall thickness
MLZ015-026 brazed and rotolock	Ø41.33/41.23 (1"5/8)	Ø25.80	Ø19.45	1.25
MLZ030-048 brazed	Ø64.05 / 63.95	Ø28.98	Ø22.63	2.00
MLZ030-048 rotolock	Ø64.05 / 63.95	Ø28.98	Ø19.45	2.00
MLZ058-076 brazed and rotolock	Ø76.15 / 76.05	Ø35.33	Ø29.05	2.00

Header outlet fitting



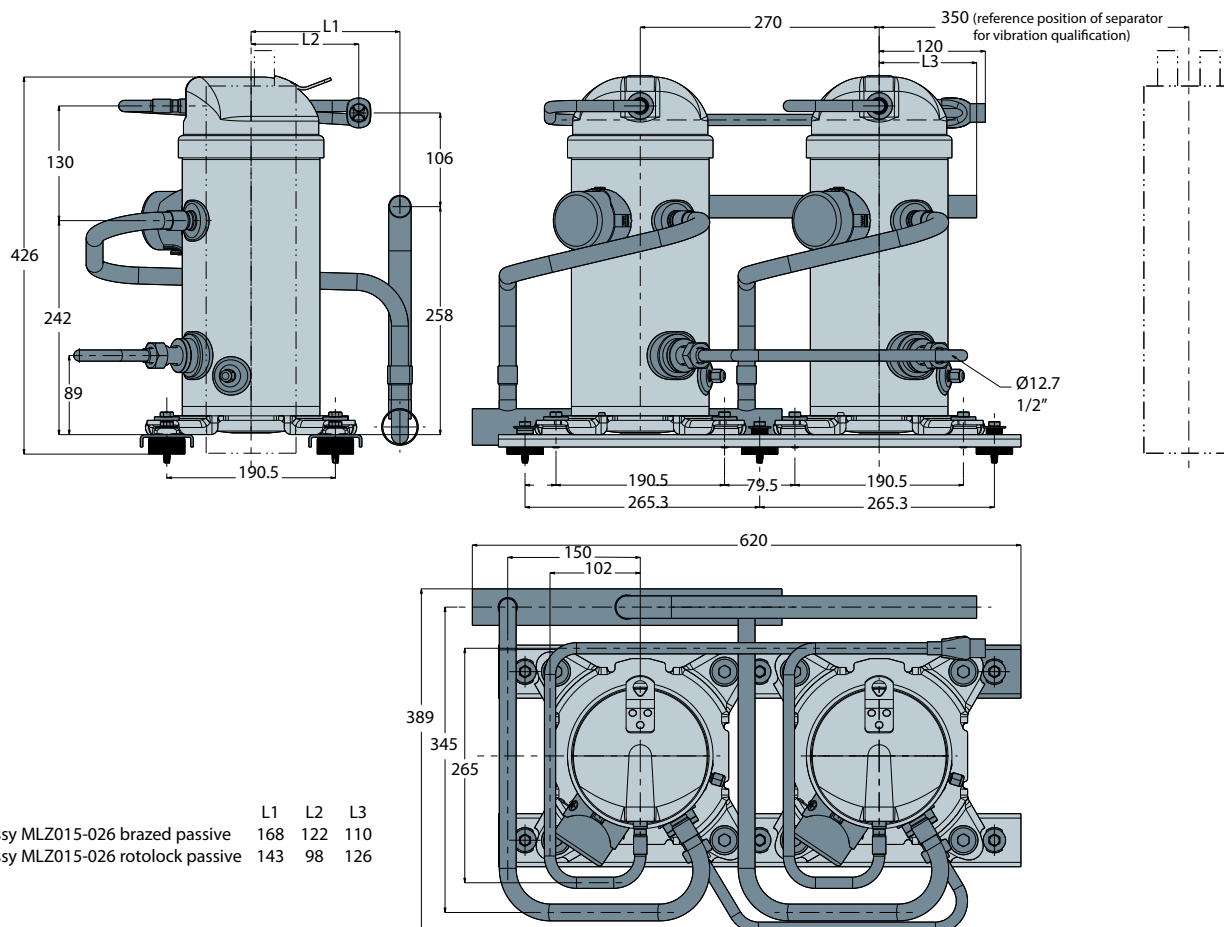
See detail page 22



Model	ØA	ØB	ØC	Minimum wall thickness
MLZ015-026 brazed and rotolock	Ø19.10/19.00 (3/4")	Ø19.50/19.40 (3/4")	88.0	1.07
MLZ030-048 brazed	Ø22.28/22.18 (7/8")	Ø22.68/22.58 (7/8")	99.5	1.14
MLZ030-048 rotolock	Ø19.10/19.00 (3/4")	Ø19.50/19.40 (3/4")	99.5	1.07
MLZ058-076 brazed and rotolock	Ø28.63/28.53 (1"1/8)	Ø29.03/28.93 (1"1/8)	105.1	1.25

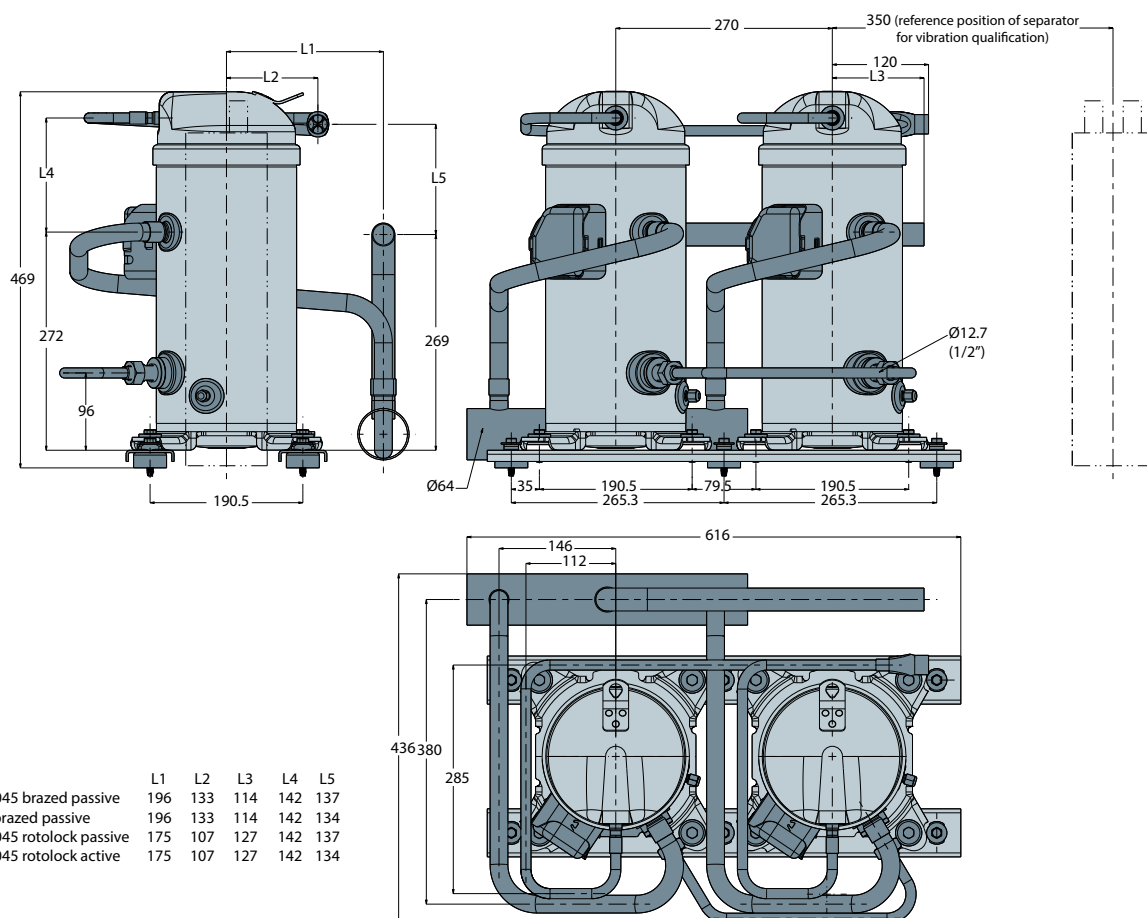
MLZ015-026

Passive



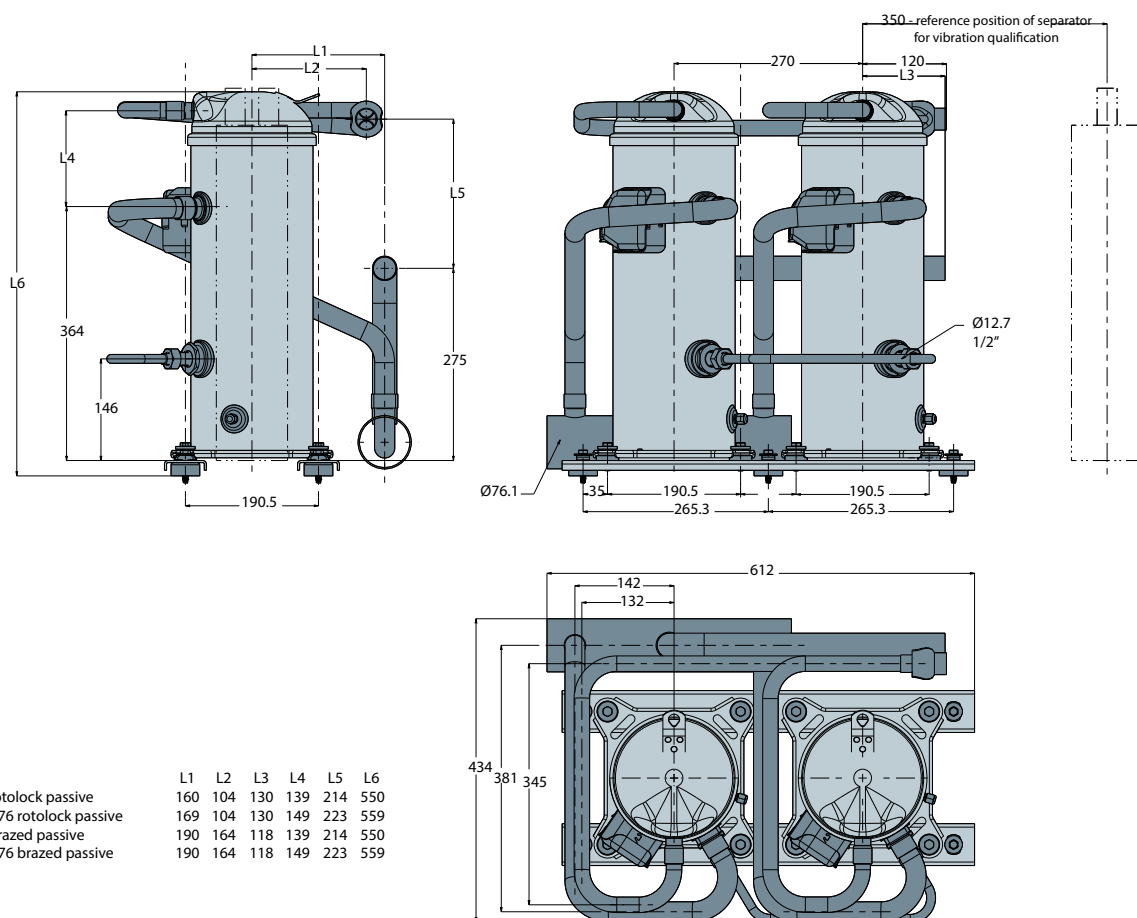
MLZ030-048

Passive



MLZ058-076

Passive



Oil equalization regulator system – With Active Oil Control

This is a more complex system which provides stable, predictable oil management under nearly all system operating conditions. Most of the rack systems operating in the field today involving scroll compressors employ this method for oil management and Danfoss application engineering recommends that this kind of system should be automatically used for installations of

3 or more compressors, provided certain design points are observed. The oil control system uses the following three basic components.

- Oil Separator
- Oil Level Regulator
- Oil Reservoir

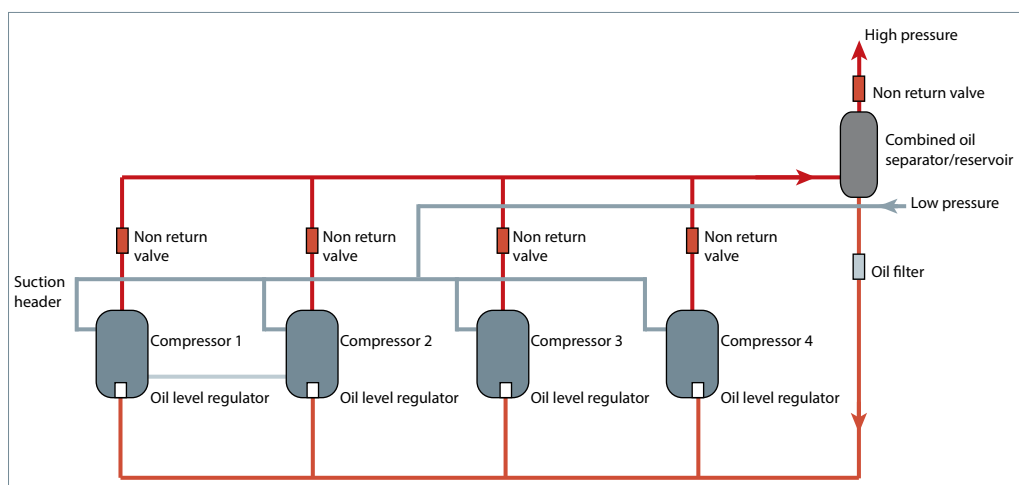
Active solution qualification

- Active solution is recommended for tandem, especially for more than 2 compressors manifolding system.
- Simple T-joint suction pipe is OK for tandem manifolding. For more than 2 compressors manifolding system it is suggested to use suction header.
- Oil Separator is recommended to use oil stored type without floating-ball valve for high pressure oil management system; for low pressure oil management system, impingement type/filter type of OS with float ball valve + oil reservoir is recommended to use.
- Using oil level regulator to control oil level

- inside compressor crankcase.
- Oil return is secured by oil separator and oil level regulator;
- Accessories: $n+1$ *NRVs, 1 OS, n *oil level regulator, 1 filter;

Basic drawing qualified to work with 2 compressors with oil separator and oil level regulator.

Our tandems have been qualified with validated piping sizes, please request our qualified drawing according to the compressor size, or get them online.


Technical features of oil level regulator tested in our laboratories

Items	Teklab TK3-S000V00018000240	AC&R OP-02	Alco OM3	Alco OM4	Alco OMB	Fasike F-OLS
Type	Electronic	Electronic	Electronic	Electronic	Electronic	Mechanical-electronic
Solenoid control	Optical sensor	Optical sensor	Optical sensor	Optical sensor	Optical sensor	Reed-switch
Power supply	24 VAC, 50/60 Hz	24 VAC, 50/60 Hz	24 VAC, 50/60 Hz	24 VAC, 50/60 Hz	24 VAC, 50/60 Hz	24 VAC, 50/60 Hz
Output signal	230VAC/3A	24V DC/2A or 120V AC/2A	230V AC/3A	230V AC/3A	230V AC/3A	N/A
Function	Oil feeding Alarming/cut off	Oil feeding Alarming/cut off	Oil feeding Alarming/cut off	Oil feeding Alarming/cut off	Oil feeding Alarming/cut off	Oil feeding
Max working pressure	45bar	35bar	31bar	45bar, for CO2/R410A	34.5bar (500psi)	28bar
Max working temperature	85°C	80°C	80°C	80°C	82°C (180°C)	120°C
Oil filling time before alarming	240s	120s	20s after Oil level is below 25% OSG.	20s after Oil level is below 25% OSG.	110s	N/A

Oil reservoir

Due to system design, loads & defrost cycles etc there will be varying amounts of oil returning back to the oil separator and because of this, a safety reserve of oil is required for successful operation of the oil regulation system. Usage of oil reservoir is very common for low pressure systems to control the variations in the oil quantity during the operation. In this configuration the oil reservoir is maintained at a pressure slightly above the compressor sump pressure using a differential pressure valve. The differential pressure required for sufficient oil flow from the oil reservoir to the compressor is system specific depending upon the application and components chosen.

The oil reservoir is the holding vessel for the standby or reserve oil which is fed from the oil separator. The reservoir must be filled with Danfoss approved lubricants like:

- Polyvinyl Ether Oil (PVE) – Danfoss Part No. 120Z5034 for HFC refrigerants
- Alkylbenzene Oil – Danfoss Part No. 7754009 for HCFC refrigerants.

During the start up of a new parallel system, some amount of oil should be added to the reservoir and Danfoss approves the above mentioned lubricants. After about two hours of

operation, the oil level should be monitored and the reservoir should be filled with oil to the upper sight glass level if found low as it is commonly observed that in a new refrigeration system, some oil will be absorbed by the refrigerant as the system operates. One should also make sure that oil should not be added again to the reservoir until the oil level falls below the lower sight glass port.

In some parallel applications, high pressure reservoir systems are used which store the oil in a common oil separator / reservoir at compressor discharge pressure. The advantage of this is that these systems do not need a separate oil receiver but make use of a combined oil separator / reservoir arrangement which normally results in a cost saving over traditional low pressure systems. From an application point of view, high pressure systems are more critical than traditional low pressure system and care must be taken to make sure that the separator / reservoir installed is of sufficient size and oil content (as per manufacturer's recommendation) so that there is always oil stored and thus avoiding discharge gas entering the compressor oil sump which could lead to some negative effects like higher discharge and oil temperatures, less of lubrication capability and the loss of efficiency due to hot-gas bypass.

Oil level regulator

According to the function, there are 3 types of oil level regulators: electronic, electromechanical and mechanical oil level regulator. According to its oil measurement principle, there are 3 types: electro-optic, Hall-effect and floating ball. The

first two types of oil level regulator use solenoid valve to control oil level, and the last one uses floating ball valve to control oil level. For high pressure oil management system, mechanical type oil level regulator is not recommended.

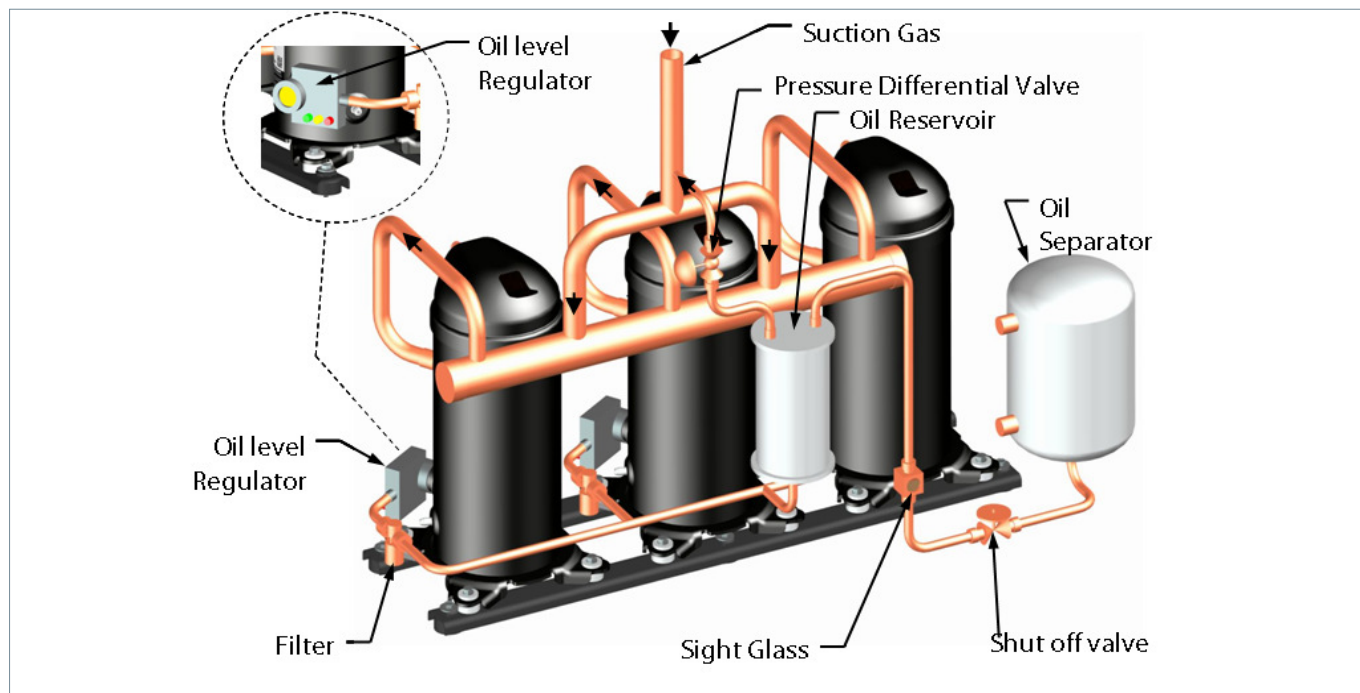
Advantages and disadvantages

Oil level regulator	Advantages	Disadvantages
Electronic-optical	Sensitive to oil level and judgment precisely. Reliable for long running Alarm and protect comp from oil starvation. Oil feeding logic can be customized Work status alarm indication by LED Small, mounted easily	✗ Foaming can affect oil level judgment ✗ Cost expensive
Electronic-Hall effective	Sensitive to oil level and judge oil level without foaming interference. Alarm and protect comp from oil starvation. Oil feeding logic can be customized Work status alarm indication by LED Small, mounted easily	✗ For long time running, iron debris can affect oil level judgment, reliable is less than optical sensor. ✗ Cost expensive
Electromechanical	Reliable for long running Cost cheap All major components replaceable.	✗ Oil level judgment isn't sensitive ✗ Big, mounted hardly ✗ No status LED indication ✗ Floating ball can be affected by some conditions (temperature, density)

The oil level regulators controls the oil level in each individual compressor sump and are designed to attach directly to the sight glass housing on compressor oil sump(as shown in schematic figure 1)using a suitable adapter. Danfoss MLZ compressors have internally 1"1/8 -18 UNEF threaded oil sight glass fitting which

can be used with a suitable adapter provided by the regulator manufacturer for mounting the oil regulators onto the compressor.

Danfoss recommends individual electronic oil control regulators over the mechanical float oil regulator system for effective oil regulation.



Most of the available commercial electronic regulators regulate the oil at 1/2 Sight Glass level using a pulse timer and when a low oil condition is detected, there is a time delay prior to oil feed to ensure stability and prevent overfill. After the delay period, oil is pulsed into the compressor sump at on/off intervals and if demand is not satisfied after certain period of continuous oil feed, a low level alarm is initiated by means of a fail-safe electrical contact. During the alarm condition the regulator will continue to pulse feed oil and once the oil returns to 1/2 glass level the alarm will reset automatically, this alarm contact can also be used to shut down the compressor in the event of a low level condition.

When commissioning parallel systems using oil regulator control systems, Danfoss highly recommends to allow sufficient time for equilibrium running conditions to be attained before making any adjustments to the oil regulator because the oil carry over rate from the scroll compressors may be low for certain conditions and it may take some time for stable oil quantities to build up and determine the total system oil requirement. One must also follow oil regulator manufacturer's guidelines for setting up the minimum pressure differential for effective functioning of the oil regulators

Conclusion

For function qualification, all the oil level regulator can be used in our refrigeration manifold system to keep safe oil levels inside compressors.

For all test models, whose solenoid valve are easy to be blocked by debris, it is recommended to install filter before oil level regulator.

Electronic oil level regulator is more convenient and safe for system, and it can give oil starvation alarm and cut off compressors.

Oil level regulator with optical sensor can judge the oil level precisely in spite of there are some oil foaming.

The oil level regulator with Hall-effect principle is sensitive to metallic debris according to some application engineer's experience.

For mechanical–electronic type of oil level regulator, it only can control the oil level, no alarm function. Low Cost makes them competitive on Low end market.

Oil separator

Oil separators serve as a critical part in oil control systems for parallel rack applications as they help to separate the oil from the high pressure gas so that it can be returned back to the compressor. Danfoss recommends selecting an oil separator should be done by comparing the system tonnage or load to the rated capacities of the oil separator as per the manufactures specification.

Based on the test result, for active solution high pressure oil management system, it is recommended to use oil-stored filter/impingement/centrifugal type OS (no float ball

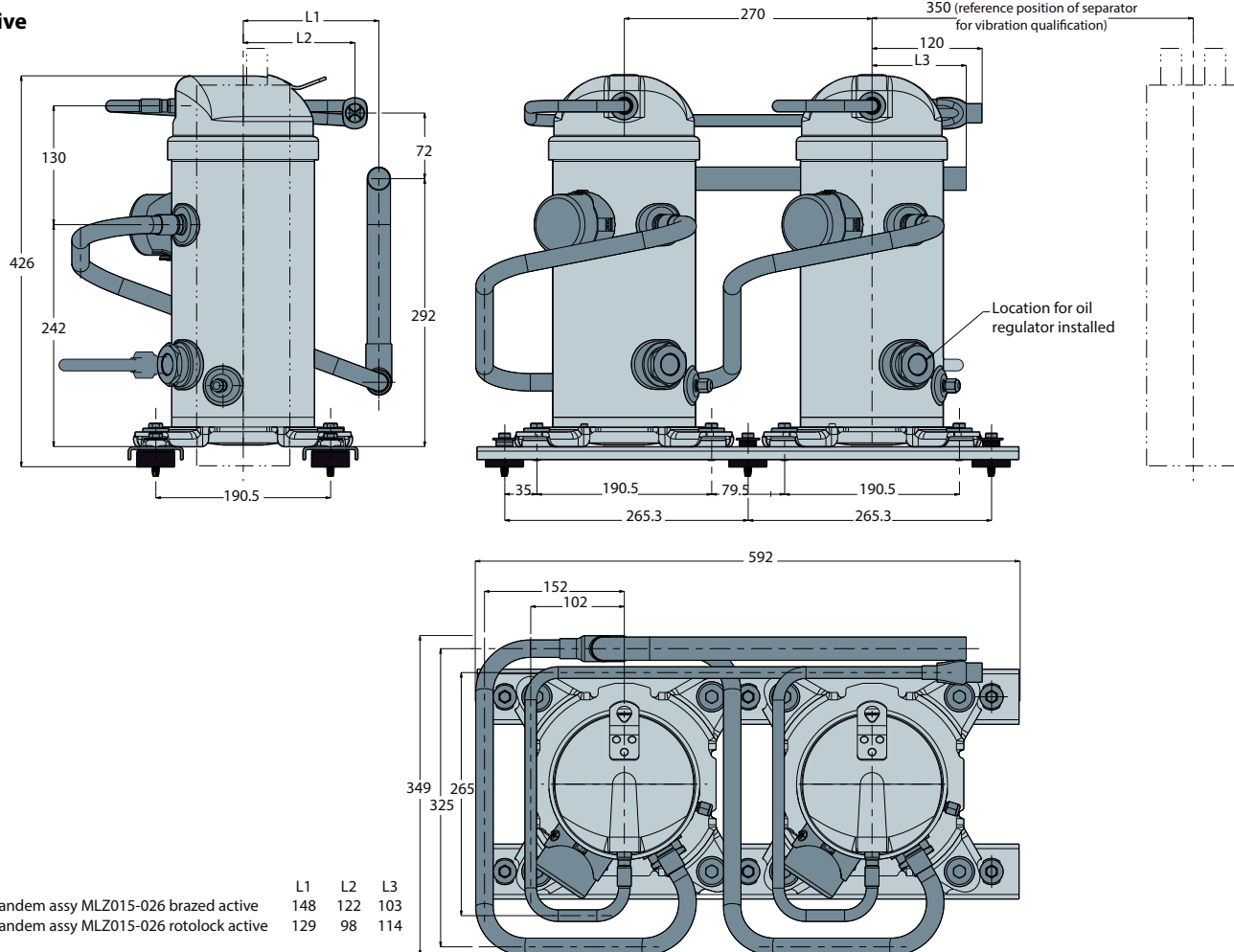
valve); for low pressure oil management system, it is recommended to use impingement/filter or turboil (for PVE oil) type OS with float ball valve.

For passive solution, it is recommended to use impingement/filter/demister / turboil (for PVE oil) type OS with float ball valve, the float ball valve can control the oil flow and act as capillary in the oil return line, therefore, there is no need to install oil capillary in the system;

We recommend Oil Separator brand Fasike, ALCO, Frigomec, Carly and AC&R.

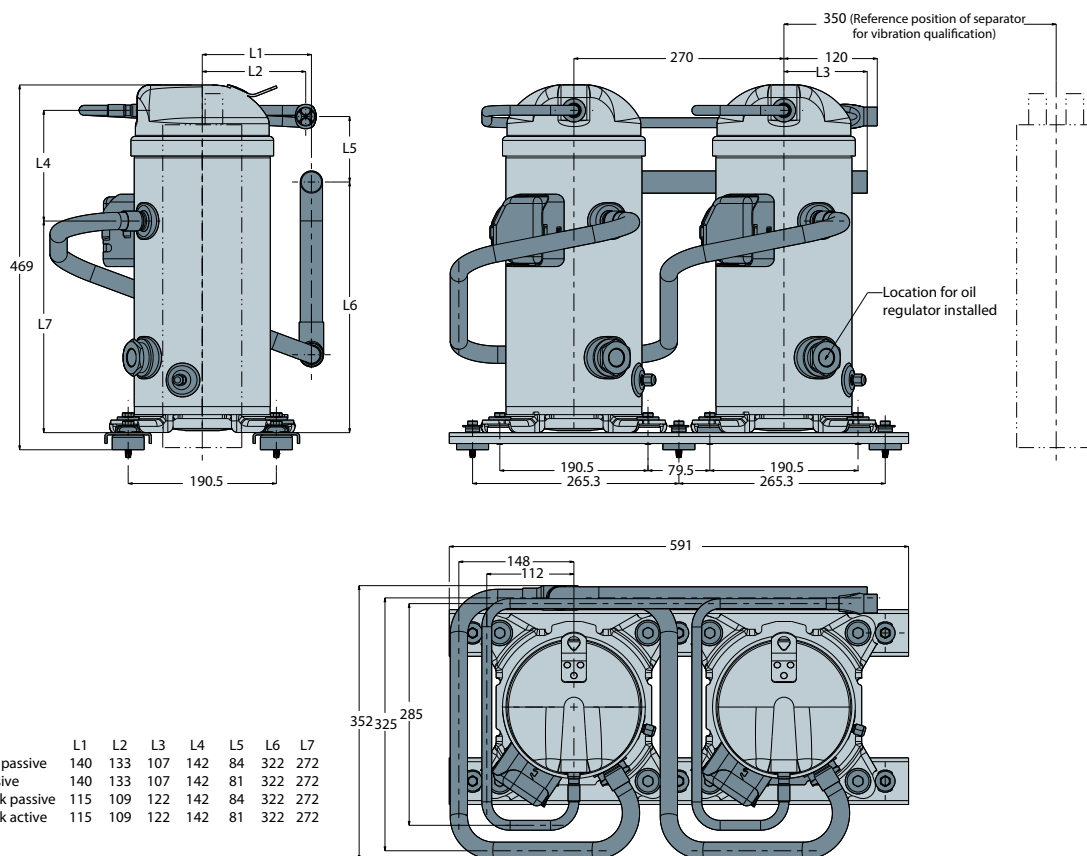
MLZ015-026

Active



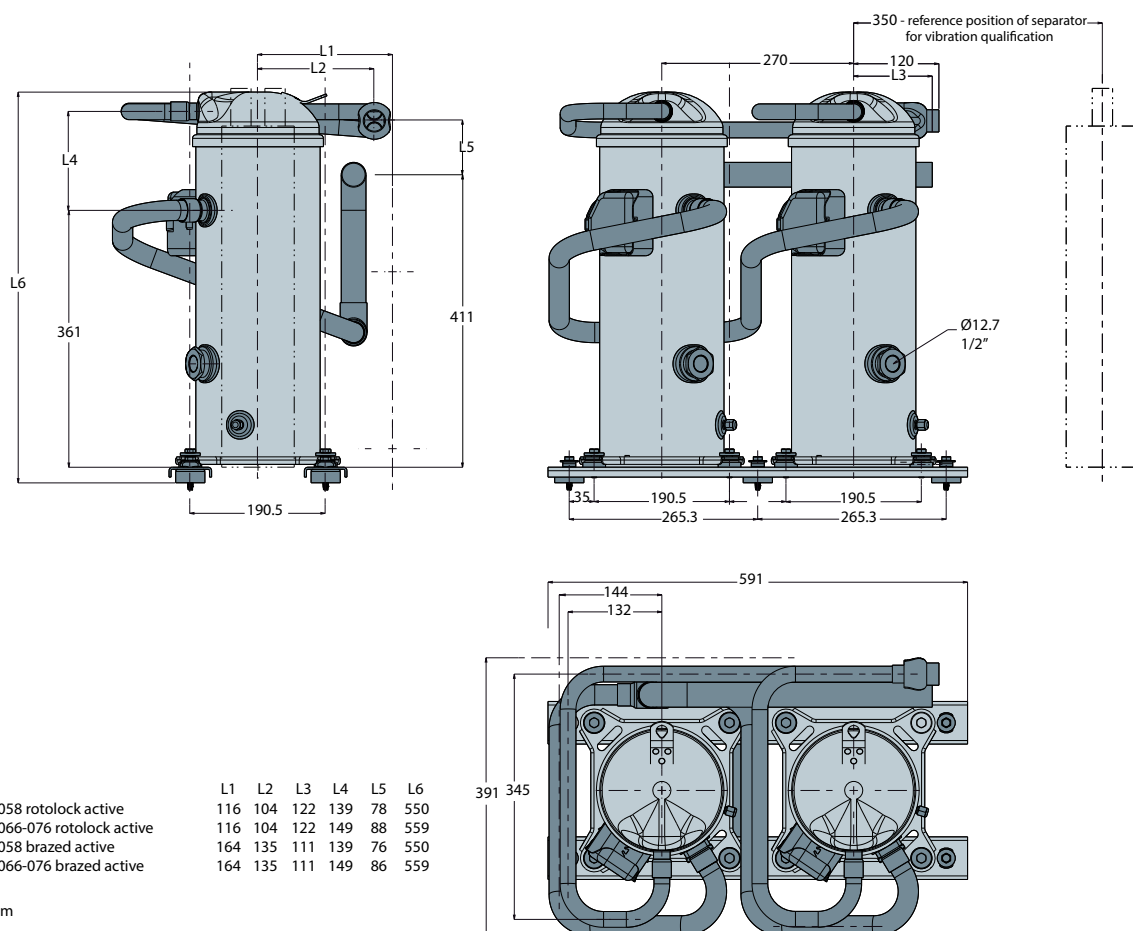
MLZ030-048

Active



MLZ058-076

Active



	L1	L2	L3	L4	L5	L6
Tandem assembly MLZ058 rotolock active	116	104	122	139	78	550
Tandem assembly MLZ066-076 rotolock active	116	104	122	149	88	559
Tandem assembly MLZ058 brazed active	164	135	111	139	76	550
Tandem assembly MLZ066-076 brazed active	164	135	111	149	86	559

All dimensions are in mm

Suction lines

When considering the design of suction lines for parallel rack applications, gas velocities in those lines should be paid attention as they may vary considerably due to fluctuations in load and number of compressors running. The gas velocity in the common suction line between evaporators and the suction header must be minimum 3,6 m/s in horizontal lines and minimum 7,6 m/s in vertical lines. Gas velocities should be controlled less than 15 m/s as they might create high noise levels and high suction line pressure drop which would in turn decrease system capacity.

For suction header gas velocity maximum velocity is 4m/s.

On vertical and horizontal liquid line velocity should be around 1,5m/s.

Danfoss recommends the suction line

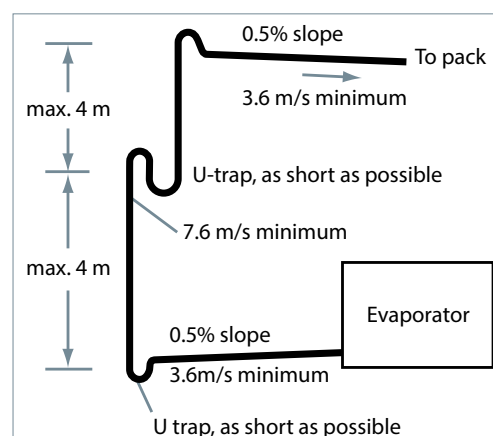
diameter needs to be calculated according to the minimum refrigerant flow (at minimum evaporating temperature and maximum condensing temperature).

The common suction line when horizontal should be sloping down toward the suction header (0.5% slope, 5 mm rise for every 1 m of run) and if the suction line must rise over 6 meters, multiple suction risers must be created every 4 meters (as shown in Figure 2) to increase the velocity of returning gas and therefore insure proper oil return. It is also important to select rotolock valve sizes according to the gas flow and not only according to pipe size.

Suction header

For efficient oil management in parallel systems the oil should return to the compressor at approximately the same rate as it leaves so that an appropriate oil level can be always maintained.

Danfoss recommends an adequately sized suction header which provides equal distribution of returning refrigerant and oil to each individual compressor. The suction lines from the header towards each individual compressor must be fitted into the suction header (as shown in below figure). This configuration will result in higher gas velocity at pick up tube inlet and proper oil return when the oil level in the suction header rises. The compressor suction lines must always enter the suction header on the topside. A recommended suction header design is shown in figure from next page.

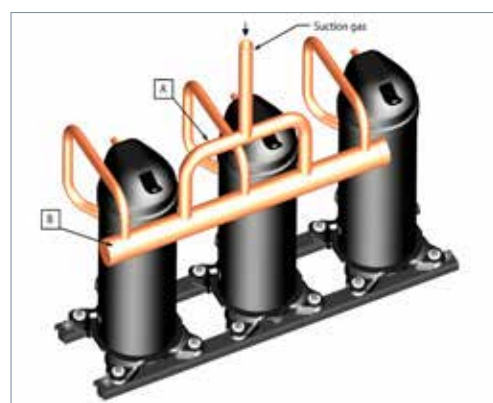


Also in case of oil equalization line system, to ensure ideal pressure equalization, the suction header must be symmetrical and the lines from the suction header to each compressor must be short and identical. These recommendations are not so critical when using an oil regulator system.

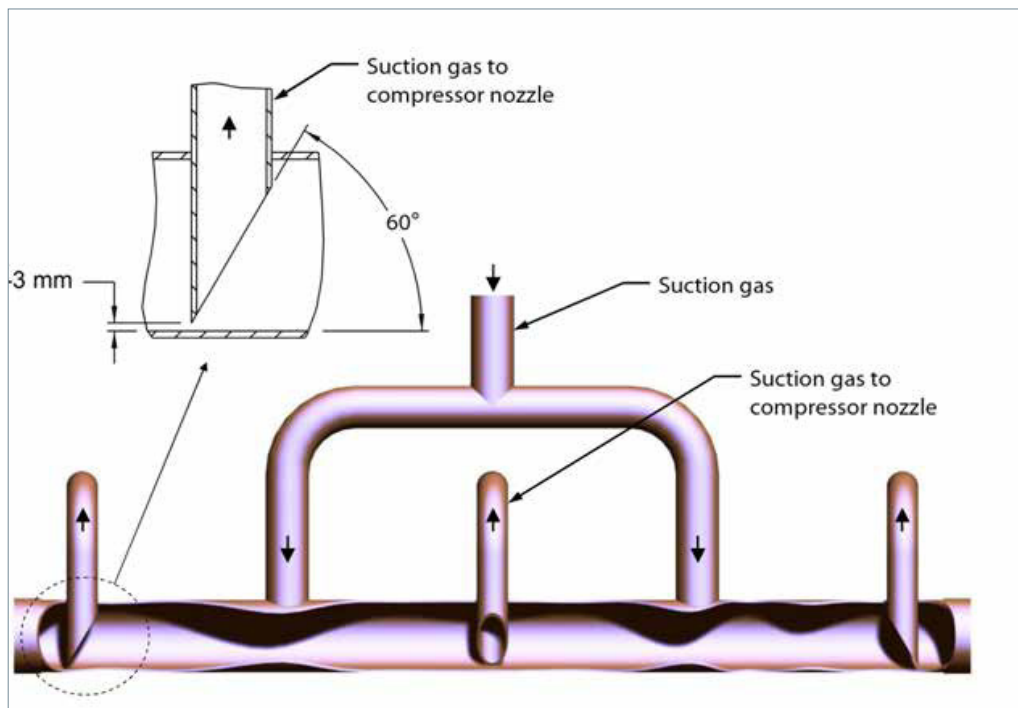
Danfoss recommends the following recommendations that are necessary for secure suction header installation:
The suction line "A" and the suction header "B" (as shown in Figure 4) must be horizontal to avoid unbalanced oil distribution.

The gas velocity in the suction header must be a maximum of 4 m/s .

The suction line and the suction header must be insulated to limit the suction gas superheat.



Suction header configuration with oil

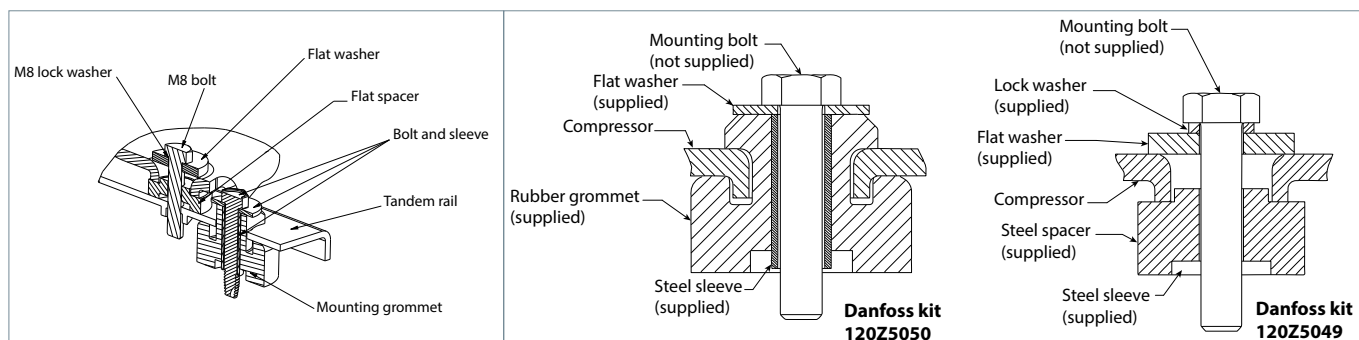
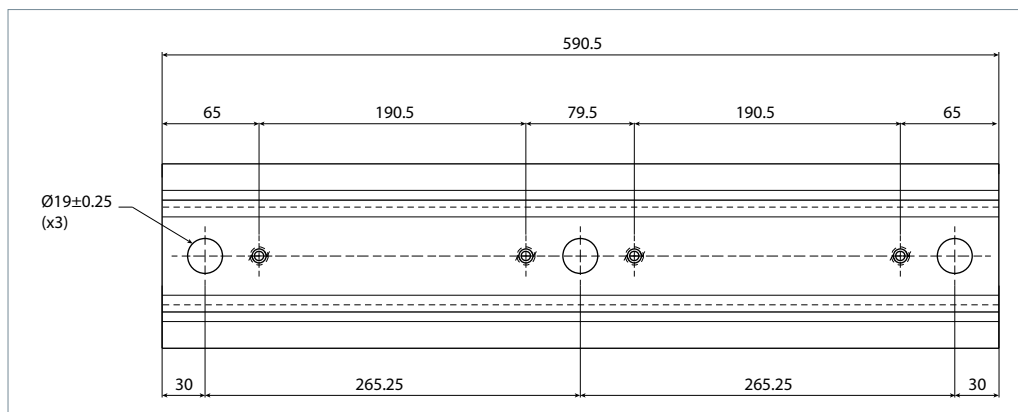


Construction detail of suction line inside the suction header

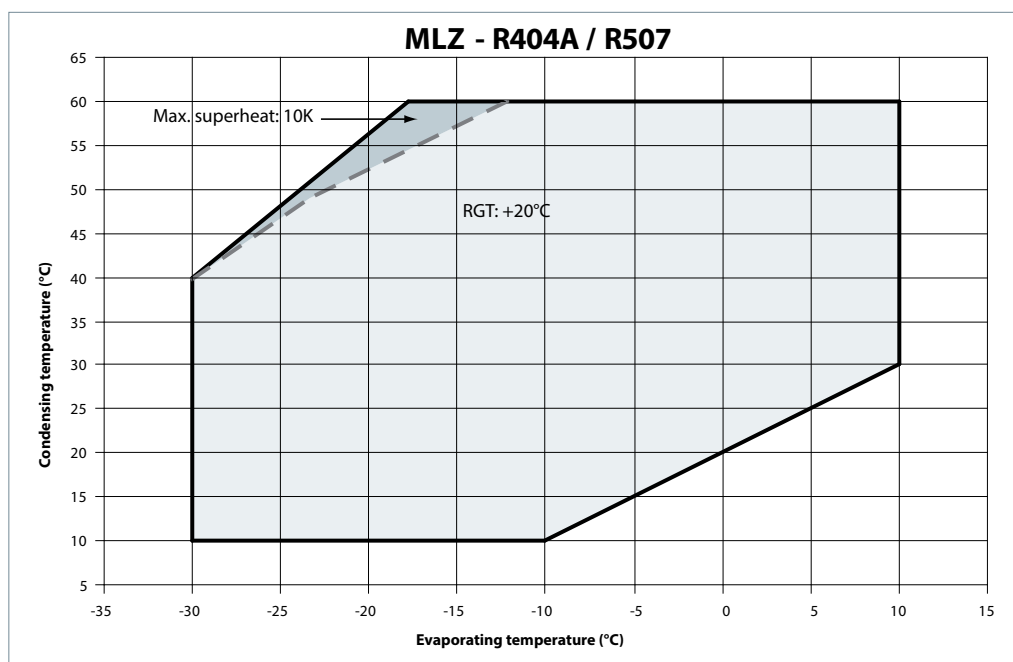
Common features for both qualifications

Compressor mounting on the rails:
The rubber grommets provided with the compressor will be placed below the rails.

Rigid spacers and washers are placed below the compressor feet.
Bolts are not provided.



Operating map



Total capacity and application envelope

In general the cooling capacity of parallel installation is slightly lower than the sum of cooling capacities of the individual compressors, which is due to the extra pressure drop in suction and discharge headers. In most of the cases this

loss is close to 1 % of the total capacity and the application operating envelope for the parallel installation will be same as that of the individual compressor used in the rack system

Compressor mounting

When installing parallel systems most of the installation and service procedures followed for basic individual compressor installation holds good. Therefore for best practices one must refer to the Application Guidelines for MLZ / MLM Refrigeration scroll compressors for detailed installation and service procedures.

Compressors must be mounted onto the racks using rigid steel grommet as shown in figure from previous page (Danfoss kit #. 120Z5049) or rubber mounts with at least 60-70 durometer (Danfoss kit #. 120Z5050) can be used for 2-6 HP size compressors so as to transmit the lowest possible disturbance to the mounting frame. One must also make sure that the lines between the suction header and the compressor suction tubing must be flexible, and must be designed to accommodate the movement which would occur especially during the start up phase. The finished assembly can be tested for flexibility by rocking the compressor on its mounts. Vibration eliminators can also used in the vertical plane if there is not sufficient flexibility in the tubing configuration.

In some parallel configuration based on system condition, the discharge pulse can give rise to resonance of the tubing and if this happens one must make sure to avoid a natural frequency around the power supply frequency for the section of tubing between the compressor and the first clamp. In most of the cases this is not possible to determine this in advance, but in the unlikely event of a resonance a slight change to the tubing configuration should help to resolve this problem.

Danfoss also recommends a common base frame, rigid enough to support the weight of the compressors, must be used for installation. The common frame may be mounted on rubber-in-shear or spring type isolators to reduce transmission of vibration to the floor. It is recommended to install all control and safety devices on an independent frame and be connected to the common frame using flexible tubing.

Running sequence

When compressors are installed for parallel applications, Danfoss recommends following a certain logical operating sequence for running

the compressors so that the run time of the compressors are equalized as much as possible.

Typical system requirements and recommendations for parallel installations are listed below:

Suction line accumulator	For parallel installations, it is recommended to always use a suction line accumulator. One must make sure to select the proper size suction line accumulator according to manufacturer recommendations. In systems with an active oil	level regulator it is best to use either one suction line accumulator per compressor or a multi-line accumulator having a connection for each compressor.
Suction filter	It is strongly recommended to install a large suction filter just before the suction header or suction accumulator. This will help to filter all foreign particles out of the installation and protect the compressors. Danfoss DCR filters	with interchangeable strainer type 48-F are recommended. These filter shells provide the possibility to install filter drier cartridges (type 48-DN), or burn out cartridges (type 48-DA), while allowing easy after sales service.
Crankcase heater	When the compressor is stopped for a longer time, liquid refrigerant can accumulate in the compressor sump. This results in reduced lubrication capability of the oil due to the different viscosity of refrigerant. In addition, the oil level appears to be higher than in reality. At restart the compressor will transport more oil with the refrigerant into the refrigeration system	than usual and to overcome these problems, Danfoss recommends to use a crankcase heater, which guarantees correct oil temperature at any time. References of crankcase heaters are given in the Selection and Application Guidelines" for MLZ / MLM Refrigeration scroll compressors. Contact your local Danfoss Application department for further information.
Thermostatic Expansion valve	When the parallel installation is serving a single evaporator system the dimensioning of the thermostatic expansion valve (TEV) becomes	critical and must be made in relation to both minimum and maximum capacity. This will ensure correct superheat control in all situations.

Run capacitors for PSC wiring



Code n°	Description	Application	Packaging	Pack size
8173231	PSC wiring Run capacitor 40 µF, motor voltage code 5 - 220-240V / 1 / 50 Hz	MLZ/MLM015	Multipack	10
120Z0051	PSC wiring Run Capacitor 70 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM019-021-026	Multipack	10
8173233	PSC wiring Run Capacitor 50 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM030	Multipack	10
8173234	PSC wiring Run Capacitor 55 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM038-042	Multipack	10

Start capacitors for CSR wiring



Code n°	Description	Application	Packaging	Pack size
120Z0399	CSR wiring Start Capacitor 145-175 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM015-019-021-026	Multipack	10
120Z0400	CSR wiring Start Capacitor 161-193 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM030	Multipack	10
8173001	CSR wiring Start Capacitor 88-108 µF, motor voltage code 5 - 220-240V / 1 / 50Hz	MLZ/MLM038-042	Multipack	10

Starting relays for CSR wiring



Code n°	Description	Application	Packaging	Pack size
120Z0393	Starting relay RVA9CKL	MLZ/MLM 015-019-021-026	Multipack	10
120Z0394	Starting relay RVA3EKL	MLZ/MLM 030	Multipack	10
120Z0395	Starting relay RVA4GKL	MLZ/MLM 038-042	Multipack	10

Solder sleeve adapter sets



Code n°	Description	Application	Packaging	Pack size
120Z0126	Rotolock adaptor set (1-1/4" ~ 3/4") , (1" ~ 1/2")	MLZ/MLM 015-019-021-026	Multipack	6
120Z0127	Rotolock adaptor set (1-1/4" ~ 7/8") , (1" ~ 1/2")	MLZ/MLM 030-038-042-045	Multipack	6
120Z0128	Rotolock adaptor set (1-1/4" ~ 7/8") , (1-1/4" ~ 3/4")	MLZ/MLM 048	Multipack	6
120Z0129	Rotolock adaptor set (1-3/4" ~ 1-1/8") , (1-1/4" ~ 7/8")	MLZ/MLM 058-066-076	Multipack	6

Rotolock nuts and sleeves kit



Code n°	Description	Application	Packaging	Pack size
120Z5074	Rotolock nuts 1"1/4 and 1" with sleeves and gaskets	MLZ/MLM015-045	Multipack	6
120Z5076	2 rotolock nuts 1"1/4 with sleeves and gaskets	MLZ/MLM048	Multipack	6
120Z5075	Rotolock nuts 1"1/4 and 1"3/4 with sleeves and gaskets	MLZ/MLM058-066-076	Multipack	6

Rotolock adapters



Code n°	Description	Application	Packaging	Pack size
120Z0366	Rotolock adaptor (1-1/4" ~ 3/4")	MLZ/MLM 015-019-021-026 suction	Multipack	10
120Z0367	Rotolock adaptor (1-1/4" ~ 7/8")	MLZ/MLM 030-038-042-045-048 suction	Multipack	10
120Z0364	Rotolock adaptor (1-3/4" ~ 1-1/8")	MLZ/MLM 058-066-076 suction	Multipack	10
120Z0365	Rotolock adaptor (1" ~ 1/2")	MLZ/MLM 015-019-021-026-030-038-042-045 discharge	Multipack	10
120Z0366	Rotolock adaptor (1-1/4" ~ 3/4")	MLZ/MLM 048 discharge	Multipack	10
120Z0367	Rotolock adaptor (1-1/4" ~ 7/8")	MLZ/MLM 058-066-076 discharge	Multipack	10

Rotolock service valves and valve sets (without gasket)


Code n°	Description	Application	Packaging	Pack size
7968004	Rotolock valve, V06, (1" Rotolock, 1/2" ODF)	Discharge MLM/Z015-026-045	Industry pack	50
8168031	Rotolock valve, V06, (1" Rotolock, 1/2" ODF)		Multipack	6
7968006	Rotolock valve, V04, (1"1/4 Rotolock, 3/4" ODF)	Suction MLM/Z015-026 Discharge MLM/Z048	Industry pack	42
8168029	Rotolock valve, V04, (1"1/4 Rotolock, 3/4" ODF)		Multipack	6
7968007	Rotolock valve, V05, (1"1/4 Rotolock, 7/8" ODF)	Suction MLM/Z030-048 Discharge MLM/Z058-076	Industry pack	36
8168030	Rotolock valve, V05, (1"1/4 Rotolock, 7/8" ODF)		Multipack	6
7968009	Rotolock valve, V02, (1"3/4 Rotolock, 1"1/8 ODF)	Suction MLM/Z058-076	Industry pack	24
8168028	Rotolock valve, V02, (1"3/4 Rotolock, 1"1/8 ODF)		Multipack	6
7703008	Valve set V02 (1"3/4 rotolock, 1"1/8 ODF), V05 (Rotolock 1"1/4, 7/8" ODF)	MLZ/MLM058-066-076	Multipack	6

Mounting kits


Code n°	Description	Application	Packaging	Pack size
120Z5005	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers	MLZ/MLM	Single pack	1
120Z5067	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers, rotolock connection kit for suction, discharge and economizer fitting for 1 scroll compressor including 3 Teflon seals, 2 nuts, 3 sleeves	MLZ/MLM015-045 LLZ013-015-018	Single pack	1
120Z5069	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers, rotolock connection kit for suction, discharge fitting for 1 scroll compressor including 3 Teflon seals, 2 nuts, 3 sleeves	MLZ/MLM048	Single pack	1
120Z5068	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers, rotolock connection kit for suction, discharge and economizer fitting for 1 scroll compressor including 3 Teflon seals, 2 nuts, 3 sleeves Teflon seals, sleeves, nuts 1"1/4 and 1"3/4	MLZ/MLM058-076 LLZ024-033	Single pack	1
120Z0407	Rigid grommets and washers for tandem / rack assembly. Set for 8 compressors	MLZ/MLM	Single pack	1

Crankcase heater


Code No	Description	Application	Packaging	Pack Size
120Z5040	Belt type crankcase heater, 65 W, 230 V, CE mark, UL (Wire length: 1270 mm)	MLZ/MLM 015-019-021-026	Multipack	4
120Z5041	Belt type crankcase heater, 55/70W, 400/460 V, CE mark, UL (Wire length: 1270 mm)	MLZ/MLM 015-019-021-026	Multipack	4
120Z5042	Belt type crankcase heater, 70 W, 575 V, CE mark, UL (Wire length: 1270 mm)	MLZ/MLM 015-019-021-026	Multipack	4
120Z0059	Belt type crankcase heater, 65 W, 230V, CE mark, UL (Wire length: 1000 mm)	MLZ/MLM 030-038-042-045-048-058-066-076	Multipack	6
120Z0060	Belt type crankcase heater, 65 W, 400 V, CE mark, UL (Wire length: 1000 mm)	MLZ/MLM 030-038-045-048-058-066-076	Multipack	6
120Z5012	Belt type crankcase heater, 70W, 460V, CE mark, UL	MLZ/MLM030-076	Multipack	4
120Z5013	Belt type crankcase heater, 70 W, 575V, CE mark, UL	MLZ/MLM030-076	Multipack	4

Discharge thermostat kit


Code No	Description	Application	Packaging	Pack Size
7750009	Discharge thermostat kit	All models	Multipack	10
7973008	Discharge thermostat kit	All models	Industry pack	50

Magnetic discharge non return valve



Code No	Description	Application	Packaging	Pack Size
120Z5046	Magnetic discharge non return valve	MLZ/MLM058-066-076	Multipack	6

Lubricant



Code No	Description	Application	Packaging	Pack Size
120Z5034	PVE lubricant, 1 litre can 320HV (FVC68D)	MLZ	Multipack	12

IP54 upgrade kit



Code No	Description	Application	Packaging	Pack Size
118U0056	IP54 upgrade kit for round terminal box	MLZ/MLM015 - 019 - 021 - 026	Multipack	6
118U0057	IP54 upgrade kit for square terminal box	MLZ/MLM030-038-042-045-048-058-066-076	Multipack	6

Acoustic hood



Code No	Description	Application	Packaging	Pack Size
120Z5043	Acoustic hood	MLZ/MLM015 - 019 - 021 - 026	Single pack	1
120Z5044	Acoustic hood	MLZ/MLM030 - 038 - 042 - 045 - 048	Single pack	1
120Z5045	Acoustic hood	MLZ/MLM058 - 066 - 076	Single pack	1

Terminal box



Code No	Description	Application	Packaging	Pack Size
120Z5015	Round terminal box (P & T version)	MLZ/MLM015 - 019 - 021 - 026	Multipack	10
120Z5018	Square terminal box (C & Q version)	MLZ/MLM030-038-042-045-058-066-076	Multipack	10

Manifolding service kit



Code No	Description	Application	Packaging	Pack Size
120Z5073	Oil equalisation kit including: 2 oil sight glass adaptors, rotolock nuts, sleeves and gaskets, feet spacers and washers for 2 compressors	All models	Multipack	6

Danfoss Commercial Compressors

is a worldwide manufacturer of compressors and condensing units for refrigeration and HVAC applications. With a wide range of high quality and innovative products we help your company to find the best possible energy efficient solution that respects the environment and reduces total life cycle costs.

We have 40 years of experience within the development of hermetic compressors which has brought us amongst the global leaders in our business, and positioned us as distinct variable speed technology specialists. Today we operate from engineering and manufacturing facilities spread across three continents.



Danfoss Scrolls



Danfoss Inverter Scrolls



Danfoss Turbocor Compressors



Danfoss Optyma Condensing Units



Secop Compressors for Danfoss



Danfoss Maneurop Reciprocating Compressors

Our products can be found in a variety of applications such as rooftops, chillers, residential air conditioners, heatpumps, coldrooms, supermarkets, milk tank cooling and industrial cooling processes.

<http://cc.danfoss.com>

Danfoss Commercial Compressors, BP 331, 01603 Trévoux Cedex, France | +334 74 00 28 29